CALIFORNIA STATE SCIENCE FAIR
2008 PROJECT SUMMARY

Name(s)
Chandan G. Lodha

Project Number
S0806

Project Title
Solar Thermal Energy: A Novel Approach Using Non-Imaging Optics with the Seebeck Effect

Abstract

Objectives/Goals
The goal of this project is to determine whether electrical energy can be generated at a reasonable efficiency by combining non-imaging optics with the Seebeck effect, to directly transform the sun's radiant heat into electricity.

Methods/Materials
Peltier (3x3 cm Bismuth Telluride), Fresnel Lens (11x11 in), Homemade Lego Mindstorms Solar Tracker (With motor and counter-weights), Small Solar Panel (2x4 in), Thermocouple, Multimeter, Aluminum Foil (2x6 in), 2 Alligator Clips, Electrical Tape, Clock

The first step is to build a solar tracker with Lego Mindstorms, to support and rotate the Fresnel lens. The small photovoltaic cell is mounted on the tracker and connected to the motor using alligator clips. Then, the non-imaging Fresnel lens concentrates sunlight onto one side of a peltier device, which causes a temperature difference to be established across the two sides of the peltier and induces an electrical voltage by the Seebeck effect. The peltier device generates electricity all day long because the sun tracker is powered by the photovoltaic cell and hourly data is recorded (temperature on both sides of the peltier, voltage and current).

Results
The solar tracker was successfully able to rotate the Fresnel lens throughout the day and concentrate sunlight onto the peltier device. The maximum temperature difference reached across the two sides of the peltier device was almost 900 degrees Celsius. The maximum induced voltage of the prototype solar concentrator was 0.62 Volts and the maximum current was 44.2 mA.

Conclusions/Discussion
My prototype solar collector was successful at converting the sun's heat energy directly into electrical energy at a reasonable efficiency. This process of collecting electrical energy via solar thermal non-imaging optics is 100 percent renewable, pollution free and has a promising future in renewable energy systems.

Summary Statement
This project utilizes a non-imaging Fresnel lens on a home-made solar tracker, to concentrate sunlight onto a peltier device, which uses the Seebeck effect to convert the sun's radiant heat into DC electricity.

Help Received
Professor Ali Shakouri discussed a number of related solar thermal ideas and helped to choose a specific project. He also provided a digital thermocouple and peltier device. Father helped buy supplies, edit abstract and provide general guidance. A neighbor lent me two alligator clips.